

[Designation of Document] Claims

[Claim 1]

An information processing system having plural memory modules, each having a memory and a control device, and

a data transmission line that connects the memory modules and transmits a value of one memory module to another memory module,

the memory of each memory module being arranged to hold a value list having values ordered in ascending order or descending order without duplication,

the information processing system being characterized in that the control device of each of the memory modules comprises:

data transmitting means that transmits a value contained in the value list to the other memory modules;

data receiving means that receives a value contained in the value list from the other memory modules; and

rank judging means that decides a global value rank in consideration of the values contained in the value lists of all the other memory modules, with reference to the value lists of the other memory modules received by the data receiving means, and stores the decided rank at a position corresponding to the value in the present memory module, in a global rank storage array for storing the global value rank.

[Claim 2]

The information processing system as claimed in claim 1, characterized in that the rank judging means generates an auxiliary rank storage array in consideration of the value list of each of the other memory modules, combines values in the auxiliary rank storage array, and decides the value in the rank storage array.

[Claim 3]

The information processing system as claimed in claim 2, characterized in that the rank judging means generates the auxiliary rank storage arrays in parallel.

[Claim 4]

The information processing system as claimed in one of claims 1 to 3, characterized in that the data transmission line connects the adjacent modules and forms a ring shape data transmission line.

[Claim 5]

The information processing system as claimed in claim 4, characterized in that the data transmission line has a first data transmission line having one or more channels that transmit data from one memory module to the other memory module, and a second data transmission line having one or more channels that transmit data from the other memory module to the one memory module,

the data transmitting means is arranged to transmit the value list of the present memory module between the adjacent

memory modules by using either the one or the other data transmission line defined as a channel for each memory module, and

the data receiving means is arranged to receive the value list of the other memory module from a defined channel by utilizing the one and the other transmission lines, in parallel with the data transmission by the data transmitting means.

[Claim 6]

The information processing system as claimed in one of claims 1 to 5, characterized in that

to realize spreadsheet data expressed as an array of records each containing an entry and entry values belonging to the entry, the memory of each of the memory modules holds an information block including a value list in which the entry values are stored in order of entry value numbers corresponding to entry values belonging to a specific entry, and a pointer array in which pointer values for designating the entry value numbers are stored in order of a unique order set array, wherein a group of the information blocks held by the respective memories forms a global information block,

the control device of each memory module comprises offset value storage means that holds an offset value indicating which position of the pointer array is occupied by the information block controlled by the present memory module, as a subset of the global information block, and

global order set array generating means that generates a global order set array in the global information block on the basis of the offset value, and

the rank judging means decides the global value rank in the value list, as the value list, and stores the decided rank in a global value number array equivalent to the global rank storage array.

[Claim 7]

The information processing system as claimed in claim 6, characterized in that the rank judging means is arranged to generate an auxiliary value number array that stores a relative value rank in consideration of the value list of each of the other memory modules, and add the sum of the difference between the relative rank and the original rank judged for each of the other memory modules, to the original rank, thereby calculating the global value rank.

[Claim 8]

The information processing system as claimed in claim 6 or 7, characterized in that same value erasing means is provided that erases the same value if the same value as the entry value in the value list of the present memory module exists among the entry values in the value list received by the data receiving means.

[Claim 9]

The information processing system as claimed in one of

claims 6 to 8, characterized in that the control device of each memory module comprises:

flag array setup means that generates, with respect to an entry to be searched for, a flag array of the same size as the value list of the entry, and provides a specific value in a flag array corresponding to an entry value that meets a search condition;

search condition judging means that specifies a value in the pointer array corresponding to the position indicated by the order set array, with respect to the entry to be searched for, and after that, specifies a value in the flag array corresponding to the position indicated by the value in the pointer array, thereby judging whether a record corresponding to the value in the order set array meets the search condition or not; and

local search means that stores a value in the order set meeting the search condition and a value in the corresponding global order set into a second order set array and a second global order set array, respectively, and

the data transmitting means transmits the second global order set array as the value list to the other modules, and the data receiving means receives the second global order set array as the value list from the other memory modules, and

second rank judging means is further provided that judges a relative rank of the present memory module's value in the

global order set array with respect to the other memory modules with reference to each of the received second global order set arrays, decides a rank in the global information block on the basis of the relative rank, and stores the rank in the global information block into a third global order set array equivalent to the global rank storage array, wherein the rank of a record that meets the search condition is indicated by the value in the third global order set array.

[Claim 10]

The information processing system as claimed in claim 9, characterized in that the second rank judging means is arranged to generate an auxiliary order set array that stores relative value ranks in consideration of the second global order set array of each of the other memory modules, and add the sum of the difference between the relative rank and the original rank judged for each of the other memory modules, to the original rank, thereby calculating the rank of the value in the global information block.

[Claim 11]

The information processing system as claimed in one of claims 6 to 10, characterized in that the control device of each memory module comprises third rank judging means that decides the rank of the value in the global order set array in accordance with a value corresponding to the global order set array, of a global value number array related to a

predetermined entry, and stores the value in the global order set array at a position corresponding to the decided rank, in a fourth global order number array, and the fourth global order set array is formed by rearranging the global order set in accordance with the value in the global value number array.

[Claim 12]

The information processing system as claimed in one of claims 6 to 11, characterized in that the control device of each memory module comprises:

number-of-existence array generating means that generates, with respect to an entry to be sorted, a number-of-existence array of the same size as the value list of the entry, and arranges the number of values in the order set array that designate each of the entry values in the value list;

cumulative sum array generating means that accumulates the values in the number-of-existence array, calculates the cumulative sum indicating the leading position of a record having the corresponding entry value when sorted within the memory module, and arranges the cumulative sum in a cumulative sum array; and

local sorting means that generates a second global value number array, the fourth global order set array and a third order set array, and arranges, on the basis of the cumulative sum in the cumulative sum array corresponding to the entry value

indicated by the value in the order set array, a global value number corresponding to entry value at a position indicated by the cumulative sum in the second global value number array, and arranges the value in the order set array and the value in the corresponding global order set array at positions indicated by the cumulative sum in the third order set array and the fourth global order set array, respectively, and

the data transmitting means transmits at least a second global value number array as the value list, and the data receiving means receives second global value number arrays of the other memory modules as the value list, and

fourth rank judging means is further provided that judges a relative rank of the present memory module's value in the second global value number array with respect to the other memory modules with reference to each of the received second global value number arrays, and stores the rank in the global information block into a fifth global order set array equivalent to the global order storage array, and the rank of the sorted record is indicated by the value in the fifth global order set array.

[Claim 13]

The information processing system as claimed in claim 12, characterized in that the fourth rank judging means is arranged to generate an auxiliary order set array that stores relative value ranks in consideration of the second global



value number array of each of the other memory modules, and add the sum of the difference between the relative rank and the original rank judged for each of the other memory modules, to the original rank, thereby calculating the rank in the global information block.

[Claim 14]

The information processing system as claimed in one of claims 1 to 13, characterized in that the control device of the memory module has a register group to be used as the array, and calculation using the array is executed without accessing the memory.

[Claim 15]

An information processing method in an information processing system comprising

plural memory modules, each having a memory and a control device, and

a data transmission line that connects the memory modules and transmits a value of one memory module to another memory module,

the memory of each memory module being arranged to hold a value list having values ordered in ascending order or descending order without duplication,

the information processing method being characterized by comprising, in each memory module:

a data transmitting step of transmitting a value

contained in the value list to the other memory modules;

a data receiving step of receiving a value contained in the value list from the other memory modules; and

a rank judging step of deciding a global value rank in consideration of the values contained in the value lists of all the other memory modules, with reference to the value lists of the other memory modules received at the data receiving step, and storing the decided rank at a position corresponding to the value in the present memory module, in a global rank storage array for storing the global value rank.

[Claim 16]

The information processing method as claimed in claim 15, characterized in that the rank judging step includes a step of generating an auxiliary rank storage array in consideration of the value list of each of the other memory modules, synthesizing a value in the auxiliary rank storage array, and deciding the value in the rank storage array.

[Claim 17]

The information processing method as claimed in claim 16, characterized in that the rank judging step includes a step of generating the auxiliary rank storages array in parallel.

[Claim 18]

The information processing method as claimed in one of claims 15 to 17, characterized in that the data transmission line connects the adjacent modules and forms a ring shape data

transmission line.

[Claim 19]

The information processing method as claimed in claim 18, characterized in that the data transmission line has a first data transmission line having one or more channels that transmit data from one memory module to the other memory module, and a second data transmission line having one or more channels that transmit data from the other memory module to the one memory module,

the data transmitting step includes a step of transmitting the value list of the present memory module between the adjacent memory modules by using either the one of the other data transmission line defined as a channel for each memory module, and

the data receiving step includes a step of receiving the value list of the other memory module from a defined channel by utilizing the one and the other transmission lines, in parallel with the data transmission by the data transmitting step.

[Claim 20]

The information processing method as claimed in one of claims 15 to 19, characterized in that

to realize spreadsheet data expressed as an array of records each containing an entry and entry values belonging to the entry, the memory of each of the memory modules holds

an information block including a value list in which the entry values are stored in order of entry value numbers corresponding to entry values belonging to a specific entry, and a pointer array in which pointer values for designating the entry value numbers are stored in order of a unique order set array, wherein a group of the information blocks held by the respective memories forms a global information block,

in each memory module, the method comprises an offset value storage step of holding an offset value indicating which position of the pointer array is occupied by the information block controlled by the present memory module, as a subset of the global information block, and

a global order set array generating step of generating a global order set array in the global information block on the basis of the offset value, and

the rank judging step includes a step of deciding the global value rank in the value list, as the value list, and storing the decided rank in a global value number array equivalent to the global rank storage array.

[Claim 21]

The information processing method as claimed in claim 20, characterized in that the rank judging step includes a step of generating an auxiliary value number array that stores a relative value rank in consideration of the value list of each of the other memory modules, and adding the sum of the

difference between the relative rank and the original rank judged for each of the other memory modules, to the original rank, thereby calculating the global value rank.

[Claim 22]

The information processing method as claimed in claim 20 or 21, characterized by further comprising a same value erasing step of erasing the same value from the value list received at the data receiving step if the same value as the entry value in the value list of the present memory module exists among the entry values in the value list received.

[Claim 23]

The information processing method as claimed in one of claims 20 to 22, characterized in that, in each memory module, the method comprises:

a flag array setup step of generating, with respect to an entry to be searched for, a flag array of the same size as the value list of the entry, and providing a specific value in a flag array corresponding to an entry value that meets a search condition;

a search condition judging step of specifying a value in the pointer array corresponding to the position indicated by the order set array, with respect to the entry to be searched for, and after that, specifying a value in the flag array corresponding to the position indicated by the value in the pointer array, thereby judging whether a record corresponding

to the value in the order set array meets the search condition or not; and

a local search step of storing a value in the order set meeting the search condition and a value in the corresponding global order set into a second order set array and a second global order set array, respectively, and that

at the data transmitting step, the second global order set array is transmitted as the value list to the other modules, and at the data receiving step, the second global order set array is received as the value list from the other memory modules, and

the method further comprises a second rank judging step of judging a relative rank of the present memory module's value in the global order set array with respect to the other memory modules with reference to each of the received second global order set arrays, deciding a rank in the global information block on the basis of the relative rank, and storing the rank in the global information block into a third global order set array equivalent to the global rank storage array, wherein the rank of a record that meets the search condition is indicated by the value in the third global order set array.

[Claim 24]

The information processing method as claimed in claim 23, characterized in that the second rank judging step includes a step of generating an auxiliary order set array that stores

relative value ranks in consideration of the second global order set array of each of the other memory modules, and adding the sum of the difference between the relative rank and the original rank judged for each of the other memory modules, to the original rank, thereby calculating the rank of the value in the global information block.

[Claim 25]

The information processing method as claimed in one of claims 20 to 24, characterized in that, in each memory module, the method comprises a third rank judging step of deciding the rank of the value in the global order set array in accordance with a value corresponding to the global order set array, of a global value number array related to a predetermined entry, and storing the value in the global order set array at a position corresponding to the decided rank, in a fourth global order number array, and the fourth global order set array is formed by rearranging the global order set in accordance with the value in the global value number array.

[Claim 26]

The information processing method as claimed in one of claims 20 to 25, characterized in that, in each memory module, the method comprises:

a number-of-existence array generating step of generating, with respect to an entry to be sorted, a number-of-existence array of the same size as the value list

of the entry, and arranging the number of values in the order set array that designate each of the entry values in the value list;

a cumulative sum array generating step of accumulating the values in the number-of-existence array, calculating the cumulative sum indicating the leading position of a record having the corresponding entry value when sorted within the memory module, and arranging the cumulative sum in a cumulative sum array; and

a local sorting step of generating a second global value number array, the fourth global order set array and a third order set array, and arranging, on the basis of the cumulative sum in the cumulative sum array corresponding to the entry value indicated by the value in the order set array, a global value number corresponding to entry value at a position indicated by the cumulative sum in the second global value number array, and arranging the value in the order set array and the value in the corresponding global order set array at positions indicated by the cumulative sum in the third order set array and the fourth global order set array, respectively, and that

at the data transmitting step, at least a second global value number array is transmitted as the value list, and at the data receiving step, second global value number arrays of the other memory modules are received as the value list, and

the method further comprises a fourth rank judging step



of judging a relative rank of the present memory module's value in the second global value number array with respect to the other memory modules with reference to each of the received second global value number arrays, and storing the rank in the global information block into a fifth global order set array equivalent to the global order storage array, and the rank of the sorted record is indicated by the value in the fifth global order set array.

[Claim 27]

The information processing method as claimed in claim 26, characterized in that the fourth rank judging step includes a step of generating an auxiliary order number array that stores relative value ranks in consideration of the second global value number array of each of the other memory modules, and adding the sum of the difference between the relative rank and the original rank judged for each of the other memory modules, to the original rank, thereby calculating the rank in the global information block.

[Claim 28]

An information processing system having plural memory modules, each having a memory and a control device, and

a data transmission line that connects the memory modules and transmits a value of one memory module to another memory module,

the memory of each memory module being arranged to hold

a value list,

the information processing system being characterized in that the control device of each of the memory modules comprises:

data transmitting means that transmits a value contained in the value list to the other memory modules;

data receiving means that receives a value contained in the value list from the other memory modules; and

rank judging means that decides a global value rank in consideration of the values contained in the value lists of all the other memory modules, with reference to the value lists of the other memory modules received by the data receiving means, and stores the decided rank at a position corresponding to the value in the present memory module, in a global rank storage array for storing the global value rank.

[Claim 29]

An information processing method in an information processing system having

plural memory modules, each having a memory and a control device, and

a data transmission line that connects the memory modules and transmits a value of one memory module to another memory module,

the memory of each memory module being arranged to hold a value list,

the information processing method being characterized by comprising:

a data transmitting step of transmitting a value contained in the value list to the other memory modules;

a data receiving step of receiving a value contained in the value list from the other memory modules; and

a rank judging step of deciding a global value rank in consideration of the values contained in the value lists of all the other memory modules, with reference to the value lists of the other memory modules received at the data receiving step, and storing the decided rank at a position corresponding to the value in the present memory module, in a global rank storage array for storing the global value rank.